DOCUMENT RESUME

ED 285 018 CE 048 088

AUTHOR Onabajo, Femi
TITLE Fundamentals of Hardware. Curriculum Improvement Project. Region II.
INSTITUTION Galveston Coll., TX.
SPONS AGENCY Texas Coll. and Univ. System, Austin. Coordinating Board.
PUB DATE 30 Jun 87
GRANT 87-1030-B-2
NOTE 103p.; For related documents, see CE 048 089-098.
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC05 Plus Postage.
DESCRIPTORS Behavioral Objectives; Community Colleges; *Computers; *Computer Science; Computer Science Education; Curriculum Guides; *Electromechanical Technology; *Equipment Maintenance; Learning Activities; Microcomputers; Postsecondary Education; Student Evaluation; *Technical Education; Two Year Colleges
IDENTIFIERS *Computer Technicians; *Troubleshooting

ABSTRACT

This course curriculum is intended for use by community college instructors and administrators in implementing a fundamentals in hardware course. A student's course syllabus provides this information: credit hours, catalog description, prerequisites, required text, instructional process, objectives, student evaluation, and class schedule. A student lecture guide consists of a sheet for each of the 15 units with unit contents, unit objectives, rationale, learning activities, vocabulary, and evaluation. Unit topics are the following: introduction; environmental and operating procedures--reducing potential problems; preparation, documentation, and tools; troubleshooting strategies and skills; troubleshooting; processors; computer architecture and assembly language; disk drives; servicing printers; writing specifications for orders; troubleshooting the main computer and keyboard; modems, monitors, cassette recorders, and game controllers; troubleshooting power supplies; microcomputer installation and upgrading; and future prospects for computer hardware. A student lab guide provides this information for each of the 15 units: objectives, required equipment and materials, learning activities, steps, and evaluation. The instructor's course syllabus outlines prerequisites, required text, references, required equipment and materials, instructional process, and student evaluation. Competency statements and a course outline are included. The instructor's guide presents this information for each unit: contents, objectives, required equipment and materials, procedures, learning activities, and evaluation. (YLB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED285018

Curriculum Improvement Project

Region II

FUNDAMENTALS OF HARDWARE

Developed by Femi Onabajo

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

P. Winstead

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Prepared by:

Galveston College

With Support From:
Coordinating Board
Texas College and University System
Division of Community Colleges
and Technical Institutes
PVEP 87-1030-B-2
Project Director: Cheryl L. Willis, Ph.D.

June 30, 1987

CE048 088

BEST COPY AVAILABLE

FOREWORD

Galveston College is not unlike other small community colleges trying to keep its curriculum in sight of rapidly changing technologies. We are unique, however, in that we were given an opportunity by the Coordinating Board of the State of Texas through a grant of Carl D. Perkins Act vocational funds to undertake a major curriculum improvement project which had as its focus curricula for accounting, the allied health professions, microcomputer applications, and office occupations. The course curriculum that you have before you is one of nine courses or modules that were developed from this project. What cannot be immediately evident to you, though, is the sense of cooperation that governed the various phases of the project. The resulting benefits to the College, its faculty, and its staff as a result of this project, were many, including increased knowledge of the curriculum improvement process, increased knowledge of the ramifications of networking microcomputers, increased awareness of the vocational programs of other community colleges, and increased awareness of the need for staff development opportunities. The enduring impact of this project will come in the months ahead as our instructors, and hopefully other instructors across Region II and the state, implement the curricula. We at Galveston College are proud of the results of the Curriculum Improvement Project and hope that your college will share the benefits.

Dr. Marc A. Nigliazzo
Vice President and Dean of Instruction
June 30, 1987

REGION II

CURRICULUM IMPROVEMENT PROJECT

EXTERNAL ADVISORY BOARD

Dr. Cheryl L. Willis, Project Director
Galveston College

Dr. John Bethscheider
Alvin Community College

Dr. Herb Miles
Brazosport College

Dr. Dorothy McNutt
College of the Mainland

Ms. Karla Back
Galveston College

Mr. Calvin Smith
Houston Community College

Mr. Cleo Savage
Lamar University at Port Arthur

Mrs. Connie McClendon
Lamar University at Orange

Dr. Bob Backstrom
Lee College

Dr. Kenne Turner
North Harris County College

Dr. Loanne Boudreaux
San Jacinto College-South Campus

Dr. Jim Coats
Wharton County Junior College

CONTRIBUTORS

AUTOMATED ACCOUNTING--Phillip Harris,
Galveston College
Galveston, Texas

PRINCIPLES OF INFORMATION PROCESSING--Gloria Rivera,
Galveston College
Galveston, Texas

INTERMEDIATE INFORMATION PROCESSING--Beth Sartor,
McLennan Community
College, Waco, Texas

ADVANCED INFORMATION PROCESSING--Linda Stanford,
McLennan Community
College, Waco, Texas

MICROCOMPUTER APPLICATIONS FOR HEALTH CARE PROFESSSIONALS--Lucy Bruce, University of Texas Medical Branch--Galveston, School of Allied Health Sciences

HEALTH INFORMATION SYSTEM SIMULATION--Beth H. Anderson and Kevin Lacobie, University of Texas Medical Branch--Galveston, School of Allied Health Sciences

DATA COMMUNICATIONS AND NETWORKING--Diane Easter
Galveston College
Galveston, Texas

OPERATING SYSTEMS--Charlene Wagstaff
San Jacinto College--
Central Campus, Pasadena,
Texas

FUNDAMENTALS OF HARDWARE--Femi Onabajo
Galveston College
Galveston, Texas

Copies of the above course curriculum are available for a nominal cost from: Division of Business and Technology
Galveston College
4015 Avenue Q
Galveston, TX 77550

A C K N O W L E D G M E N T S

This course curriculum represents but one of the many final products of the Curriculum Improvement Project. I want to take this opportunity to thank those individuals who worked so hard together to bring this project to a successful conclusion. To the administration and the Board of Regents of Galveston College I wish to express my appreciation for their willingness to accept the challenges and risks associated with a project of this magnitude and for having the forethought to see its benefits for the college and the community. To the support staff in the Business Office and the Office of Planning and Development, thank you for your patience and helpfulness in providing the project staff with everything we needed--yesterday. To Karla Back, Assistant Dean of the Division of Business and Technology, for her constant encouragement of the vision of the project, I will be forever grateful. My most heartfelt thanks, though, go to the project team--all of the curriculum writers who gave 110 percent effort whenever it was needed; the various editors and word processors who helped us along the way; Paul Fama, Research Associate, who provided constancy and consistency; and Mary James, project secretary, who kept us all sane.

Galveston, Texas
June 30, 1987

Cheryl L. Willis, Ph.D.
Project Director

P R E F A C E

The following course curriculum should be used as a resource by fellow instructors and administrators when making decisions about implementing a similar course at their institutions. This course curriculum contains five parts--student's course syllabus, student's lecture guides and student's laboratory guides for each unit of the course, instructor's course syllabus, and instructor's guides for each unit of the course. The materials presented in this course curriculum are only a suggested format for a course of this nature and, as typical with community college curriculum, will undergo revision in the future. The author and Galveston College welcome your comments regarding your experience with these materials.

STUDENT COURSE SYLLABUS

CST 2403: FUNDAMENTALS OF HARDWARE

STUDENT'S COURSE SYLLABUS

Course Title: Fundamentals of Hardware

Course Number:

CST	2403	3	2	4
Prefix	No.	Lecture Hrs.	Lab Hrs.	Credit Hrs.

Catalog Description:

An introduction to hardware fundamentals. Topics include constructing sample digital circuits, circuit design fundamentals, peripheral linkage design and interfaces; operational characteristics of and implementation factors involving different computers and peripherals (graphic adapter, multifunction cards) auxiliary storage devices, and alternative I/O devices). Optimal combinations of hardware and applications software in problem solving will also be discussed.

Prerequisites:

CSC 1301--Introductory Computing
CSC 1305--Logic and Theory
CSC 1401--BASIC Language

Text:

How to Maintain and Service Your Small Computer, by John G. Stephenson and Bob Cahill, Howard W. Sams & Co., A Division of Macmillan, Inc.

Instructional Process:

1. Student Lecture Guides provide outlines of lecture content, objectives, and requirements for each unit. Students should be encouraged to write definitions for vocabulary words provided in Student Lecture Guides. Student Lab Guides provide outlines of laboratory assignments required and materials needed.
2. There will be several laboratory assignments following the student's laboratory guide.
3. There will be several tests and laboratory assignments.

Objectives:

Upon completion of this course, the student will be able to:

1. Acquire an understanding of the concept of computer hardware.
2. Gain the ability to troubleshoot a microcomputer.
3. Perform maintenance on a microcomputer.
4. Acquire the ability to write a specification for a new system.
5. Learn microcomputer assembly from a kit.

Evaluation of Students:

Examinations: Three exams and a final will be given during the semester. The students will have an option to drop one exam out of the three. NO MAKE-UP WILL BE GIVEN WITHOUT PRIOR APPROVAL.

Laboratory Assignments: There will be fifteen lab assignments, one of which must be completed by all students after each lab section.

Final Grade Determination:

Grades for the semester will be determined based on the accumulated points earned. To determine a tentative grade, divide the total points earned by the possible points. The grading scale will be strictly: 90, 80, 70, 60 ... percent of the possible points.

Approximately 40% of the total points will be from lab assignments, 40% from the exams, and 20% from the final exam.

Class Schedule:

Week No.	Description	Due	Assignment
1	General Introduction and Computer System Today's Equipment - A Service Profile Servicing Your Equipment - The Options	Lab 1	Chap. 1,2,3
2	The Electronic Environment The Computer Can Affect the Environment Preventive Maintenance Disk-Handling Procedures File Management	Lab 2	Chap. 4
3	General Skills Documentation and Advice Test Instruments	Lab 3	Chap. 5
4	General Principles Checking Discrete Components Electromechanical Parts Integrated Circuits (IC's)	Lab 4 Exam 1	Chap. 6
5	Specific IC Devices The System	Lab 5	Chap. 7
6	Z80 68000 8086/8088 80286/80386 Others	Lab 6	**
7	General Architecture of a Microcomputer Why Assembly Language? Assemblers and Loaders Debuggers Number System Instruction Set Execution of an Assembly Language	Lab 7	**
8	Inside a Disk Drive Service Problems with Diskettes and Disk-Drives Maintaining Disk Drives Troubleshooting Disk Drives Alignment and Adjustments Checking Individual Circuits and Mechanisms.	Lab 8	Chap. 8

Week No.	Description	Due	Assignment
9	Inside a Printer Possible Printer Problems Periodic Cleaning and Maintenance Troubleshooting Troubleshooting and Adjusting Specific Subsystems	Lab 9	Chap. 9
10	Different Types of Specifications Specification and Verification Specification Testing Manufacturer's IC Numbering System Mail-order Parts Dealers Pinouts and Base Diagrams	Lab 10	Appendices a,b,c,d
11	Inside a Microcomputer Four Common Symptoms Checking Key Signals on the CPU	Lab 11	Chap. 10
12	Modems Monitors Cassette Recorders Game Controllers	Lab 12	Chap. 11
13	Power Loss in the Equipment Electrical Noise in the Power Supply High or Low Voltage from the Supply	Lab 13	Chap. 12
14	Assembly from Kit to System System Expansion and Upgrading System Performance and Evaluation Networking	Lab 14	**
15	Demand versus Price A New Technology A Workstation Approach Communications Hardware The Office of Tomorrow	Lab 15	**
16	Final Exam	**	**

Note: ** Check Student Guide for reading assignments and detailed information.

STUDENT LECTURE GUIDE

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 1

Unit Title: General Introduction

Contents of Unit:

1. General Introduction and Computer System
2. Today's Equipment - A Service Profile

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe different parts of a computer system and their function.
2. Describe the different types of computer system service problems.
3. Describe the relationship between the age of a microcomputer and its service-related problems.
4. Describe the service equipment options.

Rationale:

Students must understand the history and service profile of a microcomputer to fully appreciate a hardware course.

Learning Activities:

Lecture:
Read Chapters 1, 2, and 3

Laboratory:
Complete Student's Lab Guide #1

Terms (Vocabulary):

IC's	TTL	transistor
diodes	resistor	voltage
RAM	DC	AC
electromechanical	discrete	MTBF
modems	controllers	disk drives
cables	monitors	frequency
switches	connectors	burn in

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 2

Unit Title: **Environment and Operating Procedures - Reducing Potential Problems**

Contents of Unit:

1. The Electronic Environment
2. The Computer Can Affect the Environment
3. Other Environmental Factors
4. Preventive Maintenance
5. Disk-handling Procedures
6. File Management

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the electronic environment.
2. Describe preventive maintenance.
3. Describe disk-handling and file management procedures.

Learning Activities:

Lecture:
Read Chapter 4

Laboratory:
Complete Student's Lab Guide #2

Evaluation:

Lecture:
None

Laboratory:
Lab #2 for grading (Performance)

Terms (Vocabulary):

spikes	transients	susceptible
surge	motor	brownout
power supplies	intermittent	current flow
FET	CMOS	conductive
static	softener	filter
varistor	short-circuits	coil
MHz	fuzzy	coaxial
insulator	FRD	DOS
bugs	shield	interference

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 3

Unit Title: Preparation, Documentation, and Tools

Contents of Unit:

1. General Skills
2. Documentation and Advice
3. Test Instruments

Unit Objectives:

Upon completion of this course, the student will be able to:

1. Demonstrate good work habits.
2. Perform some safety functions.
3. Demonstrate the ability to use test equipment.
4. Demonstrate the ability to use electronic tools.

Rationale:

Students must fully understand computer hardware and associate electronic tools to be able to avoid accidents.

Learning Activities:

Lecture:
Read Chapter 5

Laboratory:
Lab #3 for grading (Performance)

Terms (Vocabulary):

edge-card connector	screwdrivers	ECO
ground	AC line (hot)	VOM
DVM	digital logic probe	LED's
inverter	troubleshoot	pulses
logic pulser	reset	set
AND gate	oscilloscope	coupling
desolder pump	sponge	solder
heat sink	wire strippers	tweezers
wrenches	nut drivers	transformer
disk exerciser	logic state analyzer	solenoids

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 4

Unit Title: Troubleshooting Strategies and Skills

Contents of Unit:

1. General Principles
2. Checking Discrete Components
3. Electromechanical Parts
4. Integrated Circuits (IC's)

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the strategic order in making repair as quickly as possible.
2. Describe good test points.
3. Stimulate circuits for tests.
4. Describe and troubleshoot discrete components of the system.

Rationale:

Troubleshooting is one of the most important aspects of this unit and of the entire course. Students must understand how to troubleshoot a microcomputer before they can fix it.

Learning Activities:

Lecture:
Read Chapter 6

Laboratory:
Lab #4 for grading (Performance)

Terms (Vocabulary):

rectifier	subsystem	interface
ROM	socket	fault
electrolytic	test pin	chassis
logic ground	signals	stimulating
peek	CPU	schematic
SPST	SPDT	DPST
DPDT	stepper motor	servo motor

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 5

Unit Title: Troubleshooting

Contents of Unit:

1. Specific IC devices:

   And gates, Or gates and Inverters
   Tristate buffers
   Nand gates, Nor gates, Flip-flops
   Counters and Dividers
   Comparatory, Timers and Multiplexer
   Shift registers
   ROM and RAM
   Voltage regulators

2. The System

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the process of troubleshooting specific IC (integrated circuit) devices.
2. Describe the pin arrangements for ROM, RAM etc.
3. Describe and be able to identify the part of the system that is faulty.
4. Troubleshoot a system.

Learning Activities:

Lecture:
Read Chapter 7

Laboratory:
Complete Student's Lab Guide #5.

Evaluation:

Lecture:
None

Laboratory:
Lab #5 for grading (Performance)

Terms (Vocabulary):

AND gates	OR gates	truth table
tristate	chip	memory trick
buffers	flip-flop	RS flip-flop
clock	JK flip-flop	comparators
counters	dividers	binary number
shift register	serial-in	parallel-in
multiplexer	address	refresh signals
sectors	tracks	density
sector adjustment	spiral motor	index timing
belt tension	write protect	index detector

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 6

Unit Title: Processors

Contents of Unit:

1. Z80
2. 68000
3. 8086/8088
4. 80286/80386
5. Others

Unit Objectives:

Upon completion of this unit, student will be able to:

1. Describe generations of processors.
2. Demonstrate a knowledge of the capabilities of each of these processors.

Rationale:

Students must be able to define the differences between each generation of processor before they can make recommendations for hardware and software enhancements.

Learning Activities:

Lecture:
Read Heathkit/Zenith Educational Systems.

Laboratory:
Complete Student's Lab Guide #6

Evaluation:

Lecture:
None

Laboratory:
Lab #6 for grading (Performance)

MSI	solid state	interfacing
data bugging	sequential logic	counters
stackable leads	logic system	bits
byte	word	8-bit
16-bit	32-bit	trainer
prestable	addresses	instruction set
superfluous	block diagrams	addressing mode

CSC 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 7

Unit Title: Computer Architecture & Assembly Language

Contents of Unit:

1. General Architecture of a Microcomputer
2. Why Assembly Language?
3. Assemblers & Loaders
4. Number System
5. Instruction Set
6. Execution of an Assembly Language

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the architecture of a microcomputer and assembly language.
2. Define different loaders and assemblers.
3. Describe the process of running an assembly language program.
4. Describe the relationship between assembly language and the architecture of a computer.
5. Define the instruction-execution cycle.

Rationale:

Students must understand the relationship between microcomputer architecture and the assembly language, in order to be able to program and set specifications for different microcomputers.

Learning Activities:

Lecture:

Read Chapters 1-3 of An Introduction to Assembly Language for the 8086 Family, by Thomas P. Skinner.

Laboratory:

Complete Student's Lab Guide #7

Evaluation:

Lecture:
None

Laboratory:
Lab #7 for grading (Performance)

Terms (Vocabulary):

program counter	PCL	PCH
status flag	index resister	accumulator
buffer	clock	crystal
drivers	bootstrap	ports
megahertz	IR	paging
loaders	assemblers	mnemonics
macros	debuggers	micro
resident	one-pass assemblers	two-pass assembler
global	symbolic	meta-assembler
pseudo-operations	label	operand

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 8

Unit Title: Disk Drives

Contents of Unit:

1. Inside a Disk drive
2. Service Problems with Diskettes and Disk Drives
3. Maintaining Disk Drives
4. Troubleshooting Disk Drives
5. Alignment and Adjustment
6. Checking Individual Circuits and Mechanisms

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate a fundamental knowledge of disk drives.
2. Demonstrate the ability to troubleshoot a disk drive.
3. Describe diskette and disk drive management.

Rationale:

Disk drives are one major component of a microcomputer that needs constant maintenance, and students must understand the fundamental makeup of disk drives before they can fix them.

Learning Activities:

Lecture:
Read Chapter 8

Laboratory:
Complete Student's Lab Guide #8

Evaluation:

Lecture:
Exam #2 (Essay and Objective)

Laboratory:
Lab #8 for grading (Performance)

Terms (Vocabulary):

head carriage	light source	clamping hub
write-protect switch	head load pad	head load arm
activity indicator	index sector pickup	spindle
drive motor	head carriage rails	innermost track
density	soft sector	hard sector
strobe disk action	spiral cam	motor base
motor shaft	stepper motor	microswitch
drive select	waveform	ejector-solenoid

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 9

Unit Title: Servicing Printers

Contents of Unit:

1. Inside a Printer
2. Possible Printer Problems
3. Periodic Cleaning and Maintenance
4. Troubleshooting
5. Troubleshooting and Adjusting Specific Subsystems

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to troubleshoot a printer.
2. Describe different printer subsystems.
3. Demonstrate a working knowledge of printer maintenance.

Rationale:

Students must know how to operate, maintain, and repair printers; and also to be able to train others to do the same.

Learning Activities:

Lecture:
Read Chapter 9

Laboratory:
Complete Student's Lab Guide #9

Evaluation:

Lecture:
None

Laboratory:
Lab #9 for grading (Performance)

Terms (Vocabulary):

clock
control indicators
drive gear
frame
bail rollers
carriage
square drive shaft
infrared light source
reset
print wires
platen
armature
daisy-wheel
cable
support rails
rotating cams
control panel
trimble
return spring
platen
print wheel
idler gear
sensors
felt wick

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 10

Unit Title: **Writing Specifications for Orders**

Contents of Unit:

1. Different Types of Specifications
2. Specifications and Verifications
3. Specification Testing
4. Manufacturer's IC Numbering System
5. Mail-order Parts Dealers
6. Pinouts and Base Diagrams

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to write a proposal for acquiring a new system.
2. Demonstrate the ability to verify and test a system upon delivery.

Rationale:

A critical attribute of any hardware course is for the student to be able to plan and write a specification for a new or used microcomputer system which meets the user's needs.

Learning Activities:

Lecture:
Read Appendices A,B,C, and D

Laboratory:
Complete Student's Lab Guide #10

Evaluation:

Lecture:
None

Laboratory:
Lab #10 for grading (Performance)

Terms (Vocabulary):

resistor color code	plastic dip	PNP
high frequency	low frequency	gate thyristor
channel fet	semiconductor	intersil
national	Motorola	Texas Instruments
Harris	monolithic memory	pinouts
timers		

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 11

Unit Title: **Troubleshooting the Main Computer and Keyboard**

Contents of Unit:

1. Inside a Microcomputer
2. Four Common Symptoms
3. Checking Key Signals on the CPU
4. Troubleshooting the Keyboard

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to troubleshoot the main computer and keyboard.
2. Define key signals from the CPU.
3. Define the common symptoms surrounding microcomputer problems.

Rationale:

Before a microcomputer malfunction can be traced, students must be able to recognize any problems within the controller or main memory of the system.

Learning Activities:

Lecture:
Read Chapter 10

Laboratory:
Complete Student's Lab Guide #11

Evaluation:

Lecture:
None

Laboratory:
Lab #11 for grading (Performance)

Terms (Vocabulary):

I/O	power supply	ROM
RAM	disk drive controller	keyboard
video interface	monitor	video RAM
video driver	keyboard decoder	CPU
modem	printer	data bug
clock	reset	data
crystal	oscillator	buffer
network	data strobe	circuits

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 12

Unit Title: **Modems, Monitors, Cassette Recorders and Game Controllers**

Contents of Unit:

1. Modems
2. Monitors
3. Cassette Recorders
4. Game Controllers

Unit Objectives:

Upon completion of this unit, students will be able to:

1. Demonstrate a working knowledge of modem, monitor, cassette recorder, and game controller management.
2. Demonstrate the ability to troubleshoot modems, monitors, cassette recorders and game controllers.

Rationale:

Students must fully understand the fundamental principles of modems, monitors, cassette recorders, and game controllers before they can communicate with another microcomputer or device.

Learning Activities:

Lecture:
Exam #3 (Essay & Objective)

Laboratory:
Lab #12 for grading (Performance)

Terms (Vocabulary):

RS-232	stop bits	baud rate
modem	terminal	logic ground
significant bit	intermittent problem	monitor
crystal	scanning	electron gun
electron beam	phosphorus screen	capstan
flywheel	supply spindle	joystick

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 13

Unit Title: **Troubleshooting Power Supplies**

Contents of Unit:

1. Power Loss in the Equipment
2. Electrical Noise in the Power Supply
3. High or Low Voltage from the Power Supply

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate a working knowledge of power supplies.
2. Demonstrate the ability to troubleshoot a power supply.
3. Demonstrate the ability to fine tune a power supply.

Rationale:

Students must be able to regulate the power source to a microcomputer. If there are irregularities in the power supply, the microcomputer will not work.

Learning Activities:

Lecture:
Read Chapter 12

Laboratory:
Complete Student's Lab Guide #13

Evaluation:

Lecture:
None

Laboratory:
Lab #13 for grading (Performance)

Terms (Vocabulary):

transformer	voltage	filter
capacitor	rectifier	noise
signal	scope	ripple
RAM's	IC's	heat sink
TTL	slave	grawing down
oscillator	SCR	battery

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 14

Unit Title: **Microcomputer Installation and Upgrading**

Contents of Unit:

1. Assembly From Kit to System
2. System Expansion and Upgrading
3. System Performance and Evaluation
4. Networking

Unit Objectives:

Upon the completion of this unit, the student will be able to:

1. Demonstrate the ability to assemble a microcomputer.
2. Describe system expansion and upgrading.
3. Demonstrate the ability to analyze and evaluate system performance.

Rationale:

One of the most important aspects of this course is for students to be able to assemble a microcomputer from a kit to a full system so they will be able to install them on the job.

Learning Activities:

Lecture:
Read Computer Shopper magazine

Laboratory:
Complete Student's Lab Guide #14

Evaluation:

Lecture:
None

Laboratory:
Lab #14 for grading (Performance)

Terms (Vocabulary):

(Same as previous units)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LECTURE)

Unit 15

Unit Title:

Future Prospects for Computer Hardware

Contents of Unit:

1. Demand versus Price
2. A New Technology
3. A Workstation Approach
4. Communications Hardware
5. The Office of Tomorrow

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the microcomputer's past and present, and explain the future of computer hardware.

Rationale:

Students must have an idea of where hardware technology is going in order to make reasonable management decisions.

Learning Activities:

Lecture:
Read Computer Shopper magazine

Laboratory:
Complete Student's Lab Guide #15

Evaluation:

Lecture:
Preparation for final exam

Laboratory:
Lab #15 for grading (Performance)

Terms (Vocabulary):

(All units combined)

STUDENT LAB GUIDE

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 1

Unit Title: General Introduction

Time Required:

2 hours

Contents of Unit:

1. General Introduction and Computer System
2. Today's Equipment - A Service Profile

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe different parts of a computer system and their function.
2. Describe the breakdown of computer system service problems.
3. Describe the relationship between the age of a microcomputer and its service-related problems.
4. Describe the service equipment options.

Equipment and Materials Required:

Tool box
Workspace
Lockers

Learning Activities:

Complete Student's Lab Guide #1

Steps:

1. Tour of computer hardware facilities.
2. Check out individual tool boxes.
3. Take inventory of all tools and sign checkout forms.
4. Arrange your tools and become familiar with their names.
5. Lock up your tool box when you finish.

EVALUATION:

Lab #1 for grading (Performance)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 2

Unit Title: Environment and Operating Procedures - Reducing Potential Problems

Time Required:

2 hours

Contents of Unit:

1. The Electronic Environment
2. The Computer Can Affect the Environment
3. Other Environmental Factors
4. Preventive Maintenance
5. Disk-handling Procedures
6. File Management

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Decribe the electronic environment.
2. Describe preventive maintenance.
3. Describe disk-handling and file management procedures.

Equipment and Materials Required:

Tool box
Coaxial cable
Diskettes
Twin lead
Varistor
AC line & cable

Learning Activities:

Complete Student's Lab Guide #2

Steps:

1. Take out your tool box and arrange tools on your workspace.
2. Check to see whether you need a surge protector for fluctuations in voltage. If so, install one in your workspace.
3. Check to see if you have a static problem. If so, get an anti-static rug to cover your workspace.
4. Check to see if you have a high voltage problem. If so, install a varistor.
5. Check for a significant amount of interference, smoke, and/or chemicals around the workspace, and check the cooling system. If there are problems in any of these areas, take proper action to rectify them.
6. Do 4.5 & 4.6 on pages 28-29 in the textbook.

Evaluation:

Lab #2 for grading (Performance)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 3

Unit Title: **Preparation, Documentation, and Tools**

Time Required:

2 hours

Contents of Unit:

1. General Skills
2. Documentation and Advice
3. Test Instruments

Unit Objectives:

Upon completion of this course, the student will be able to:

1. Demonstrate good work habits.
2. Perform some safety functions.
3. Demonstrate the ability to use some test equipment.
4. Demonstrate the ability to use some electronic tools.

Equipment and Materials Required:

Nut drivers
Screwdrivers
Scissors & pliers
Strippers
Resistor tester
Oscilloscope
Logic probe
Digital logic probe
Digital volt-ohm-milliammeter
Volt-ohm-milliammeter

Learning Activities:

Complete Student's Lab Guide #3

Steps:

1. Get your volt-ohm-milliammeter and check for continuity.
2. If the inside of your computer is accessible, do the following to familiarize yourself with the logic probe: Refer to the documentation for the equipment and find two source points for +5-V DC and ground.
3. Check the signals around the CPU. The test should reveal the following:
   (a) The clock should show a constant string of pulses.
   (b) Each of the addresses and data lines should show constant activity.
   (c) The reset line should pulse whenever you hit the reset button, or boot the computer.
4. Do excercise 5.3.3 for test on your logic pulser.
5. Go through 5.3.4 to get familiar with the oscilloscope.
6. If you have more time, run a test for transistor steps on 5.3.7.
7. Follow 5.3.8 on using your soldering iron.

Evaluation:

Lab #3 for grading (Performance)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 4

Unit Title: Troubleshooting Strategies and Skills

Time Required:

2 hours

Contents of Unit:

1. General Principles
2. Checking Discrete Components
3. Electromechanical parts
4. Integrated Circuits (IC's)

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the electronic environment.
2. Demonstrate the knowledge of preventive maintenance.
3. Demonstrate the knowledge of disk-handling and file management procedures.

Equipment and Materials Required:

Capacitors
Resistors
Fuses
A microcomputer
All materials from Unit #3

Learning Activities:

Complete Student's Lab Guide #4

Steps:

1. Locate a circuit on a schematic and find the actual circuit on the board. For example, locate:

   ROM IC's
   CPU
   Transistor
   Capacitor

2. Since circuit boards are subject to cracks, examine one visually for such cracks.
3. Test a resistor following the guidelines on 6.2.3 on page 66.
4. Test a diode, following the guidelines on 6.2.4 page 66.
5. Test a capacitor, following the guidelines on 6.2.7 page 67.
6. If you have more time, do the following for testing:
   (a) Fuses - follow 6.2.8
   (b) Transformer - follow 6.2.9
   (c) Transistors - follow 6.2.11
   (d) Switches - follow 6.3.1
   (e) Solenoids - follow 6.3.3
   (f) Stepper Motor/Servo Motor - follow 6.3.5
7. If you like to identify IC's - follow 6.4.1.

Evaluation:

Lab #4 for grading (Performance)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 5

Unit Title: **Troubleshooting**

Time Required:

2 hours

Contents of Unit:

1. Specific IC devices:

   And gates, Or gates and Inverters
   Tristate buffers
   Nand gates, Nor gates, Flip-flops
   Counters and Dividers
   Comparatory, Timers and Multiplexer
   Shift registers
   ROM and RAM
   Voltage regulators

2. The System

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the process of troubleshooting specific IC (integrated circuit) devices.
2. Describe the pin arrangements for ROM, RAM etc.
3. Describe and be able to identify the part of the system that is faulty.
4. Troubleshoot a system.

Equipment and Materials Required:

All materials from Units #3 and #4
Hardware diagnostic diskette

Learning Activities:

Complete Student's Lab Guide #5

Steps:

1. Use diagnostic software to test the ROM.
2. Check the signals around the RAM to know when to read and when to write.
3. Check the voltage regulator integrated in the power supply - follow 7.1.14.

Evaluation:

Lab #5 for grading (Performance)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 6

Unit Title: Processors

Time Required:

2 hours

Contents of Unit:

1. Z80
2. 68000
3. 8086/8088
4. 80286/80386
5. Others

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe different generations of processors.
2. Describe the capabilities of each of these processors.

Equipment and Materials Required:

Different processor chips
All of Units #3 and #4
Tool box

Learning Activities:

Complete Student's Lab Guide #6

Steps:

1. Identify the kind of processor on the motherboard.
2. What kind of processor can replace it?
3. Using the soldering iron, take out the processor, count the number of pins, and identify each of them.
4. Put the processor back in the socket and test whether it is working or not.

Evaluation:

Lab # 6 for grading (Performances)

CSC 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 7

Unit Title: **Computer Architecture & Assembly Language**

Time Required:

2 hours

Contents of Unit:

1. General Architecture of Microcomputer
2. Why Assembly Language?
3. Assemblers & Loaders
4. Number System
5. Instruction Set
6. Exeeution of an Assembly Language

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the architecture of a microcomputer and assembly language.
2. Define different loaders and assemblers.
3. Describe the process of running an assembly language program.
4. Describe the relationship between assembly language and the architecture of a computer.
5. Define the instruction-execution cycle.

Equipment and Materials Required:

Tool box
ASM Assembler diskettee
All materials from Units #3 & #4

Learning Activities:

Complete Student's Lab Guide #7

Steps:

1. Trace down the instruction-execution cycle on the motherboard.
2. Go through the process of assembling and debugging an assembly language using a sample program.
3. Execute this program and record your results.
4. Modify the program and go through steps 2 and 3 again.

Evaluation:

Lab #7 for grading (Performance)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 8

Unit Title: Disk Drives

Time Required:

2 hours

Contents of Unit:

1. Inside a Disk Drive
2. Service Problems with Diskettes and Disk Drives
3. Maintaining Disk Drives
4. Troubleshooting Disk Drives
5. Alignment and Adjustment
6. Checking Individual Circuits and Mechanisms

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate a fundamental knowledge of disk drives.
2. Demonstrate the ability to troubleshoot a disk drive.
3. Describe diskette and disk drive management.

Equipment and Materials Required:

Tool box
Diskettes
Disk drives

Learning Activities:

Complete Student's Lab Guide #8

Steps:

1. Perform preventive maintenance on the disk drives:
   (a) Clean the heads - follow 8.3.1
   (b) Lubricate - follow 8.3.4
2. Go through the problem and solution on page 104 - 121, i.e 8.4.1 to 8.6.15.

Evaluation:

Lab #8 for grading (Performance)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 9

Unit Title: Servicing Printers

Time Required:

2 hours

Contents of Unit:

1. Inside a Printer
2. Possible Printer Problems
3. Periodic Cleaning and Maintenance
4. Troubleshooting
5. Troubleshooting and Adjusting Specific Subsystems

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to troubleshoot a printer.
2. Describe different printer subsystems.
3. Demonstrate a working knowledge of printer maintenance.

Equipment and Materials Required:

Tool box
Printers

Learning Activities:

Complete Student's Lab Guide #9

Steps:

1. Go through the following list of common symptoms and causes:
   (a) Intermittent problems: Go through 9.4.1.
   (b) Printer starts printing then stops prematurely: go to 9.4.2.
   (c) Printer is completely dead: go to 9.4.3.
   (d) No print action, yet front panel indicator is on: go to 9.4.4.
   (e) Carriage does not move: go to 9.4.5.
   (d) Carriage moves but does not print: go to 9.4.6.
   (e) Printing action, but no characters printing: go to 9.4.7.
   (f) Printer operates slowly: go to 7.4.8.

2. If you have more time, go through pages 134-136.

Evaluation:

Lab #9 for grading (Performance)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 10

Unit Title: **Writing Specifications for Orders**

Time Required:

2 hours

Contents of Unit:

1. Different Types of Specifications
2. Specifications and Verifications
3. Specification Testing
4. Manufacturer's IC Numbering System
5. Mail-order Parts Dealers
6. Pinouts and Base Diagrams

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to write a proposal for acquiring a new system.
2. Demonstrate the ability to verify and test a system upon delivery.

Equipment and Materials Required:

Tool box
Specification sheets

Learning Activities:

Complete Student's Lab Guide #10

Steps:

1. You have just been hired as a hardware specialist in a small company. Write a specification to meet the following user's request:

   * A microcomputer with 640K memory.
   * Must have sufficient memory for storing large amounts of data.
   * Must have a mechanism for backup of the storage media.
   * Needs a printer, and a color monitor.
   * Needs a math co-processor for their applications

2. Write out the specification and the estimated cost.
3. Verify the parts on delivery.
4. Test each part for performance.

Evaluation:

Lab #10 for grading (Performance)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 11

Unit Title: **Troubleshooting the Main Computer and Keyboard**

Time Required:

2 hours

Contents of Unit:

1. Inside a Microcomputer
2. Four Common Symptoms
3. Checking Key Signals on the CPU
4. Troubleshooting the Keyboard

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to troubleshoot the main computer and the keyboard.
2. Define key signals from the CPU.
3. Define the common symptoms surrounding microcomputer problems.

Equipment and Materials Required:

Microcomputer
Tool box
Keyboard

Learning Activities:

Complete Student's Lab Guide #11

Steps:

1. Go to the following symptoms and possible solutions:
   (a) Computer starts operating then stops:
   - follow 10.2.1
   (b) Computer makes random errors:
   - follow 10.2.2
   (c) At power on, garbage on screen:
   - follow 10.2.3
   (d) Computer seems dead at power on; no response to commands:
   - follow 10.2.4
   (e) Checking the clock signal:
   - follow 10.3.1
2. To troubleshoot keyboard: - follow 10.4 on page 155

Evaluation:

Lab #11 for grading (Performance)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 12

Unit Title: **Modems, Monitors, Cassette Recorders and Game Controllers**

Time Required:

2 hours

Contents of Unit:

1. Modems
2. Monitors
3. Cassette Recorders
4. Game Controllers

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate a working knowledge of modem, monitor, cassette recorder, and game controller management.
2. Demonstrate the ability to troubleshoot modems, monitors, cassette recorders and game controllers.

Equipment and Materials Required:

Modems
Monitor
Tool box
Controllers
Microcomputer

Learning Activities:

Complete Student's Lab Guide #12

Steps:

1. Modems:
   (a) Run the modem self-test
   (b) For intermittent problems:
   - follow 11.1.2
   (c) For no ready indicator problems:
   - follow 11.1.3
2. Monitor:
   (a) Troubleshooting monitors:
   - follow 11.2.1
3. Cassette Recorders:
   (b) Troubleshooting Cassette Recorders:
   (i) Intermittent problem, bad output:
   - follow 11.3.1
   (ii) Tape transport problems:
   - follow 11.3.2
   (iii) No output at all:
   - follow 11.3.3
4. Game Controllers:
   (a) Troubleshooting:
   - follow 11.4

Evaluation:

Lab #12 for grading (Performance)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 13

Unit Title: **Troubleshooting Power Supplies**

Time Required:

2 hours

Contents of Unit:

1. Power Loss in the Equipment
2. Electrical Noise in the Power Supply
3. High or Low Voltage from the Supply

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate a working knowledge of power supplies.
2. Demonstrate the ability to troubleshoot a power supply.
3. Demonstrate the ability to fine tune a power supply.

Equipment and Materials Required:

Power supply
Tool box
Microcomputer

Learning Activities:

Complete Student's Lab Guide #13

Steps:

1. Troubleshooting:
   (a) Power loss in the equipment:
   - follow 12.1
   (b) Electrical noise in the power supply:
   - follow 12.2

Evaluation:

Lab #13 for grading (Performance)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 14

Unit Title: **Microcomputer Installation and Upgrading**

Time Required:

2 Hours

Contents of Unit:

1. Assembly From Kit to System
2. System Expansion and Upgrading
3. System Performance and Evaluation
4. Networking

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to assemble a microcomputer.
2. Describe system expansion and upgrading.
3. Demonstrate the ability to analyze and evaluate system performance.

Equipment and Materials Required:

Video on microcomputer assembly
Tool box
Microcomputer kit

Learning Activities:

Complete Student's Lab Guide #14

Steps:

1. Follow the video on installation step-by-step.
2. Repeat until proficient.

Evaluation:

Lab #14 for grading (Performance)

CST 2403: Fundamentals of Hardware

STUDENT'S GUIDE (LABORATORY)

Unit 15

Unit Title: **Future Prospects for Computer Hardware**

Time Required:

2 hours

Contents of Unit:

1. Demand versus Price
2. A New Technology
3. A Workstation Approach
4. Communications Hardware
5. The Office of Tomorrow

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the microcomputer's past and present, and explain the future prospects for computer hardware.

Equipment and Materials Required:

Tool box
Microcomputer

Learning Activities:

Complete Student's Lab Guide #15

Steps:

1. Go on a field trip to an installation with modern computer equipment.
2. Write a one-page paper on the future of computer hardware.

Evaluation:

Lab #15 for grading (Performance)

INSTRUCTOR'S COURSE SYLLABUS

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S COURSE SYLLABUS

Course Title: Fundamentals of Hardware

Course Number:

CST	2403	3	2	4
Prefix	No.	Lecture Hrs.	Lab Hrs.	Credit Hrs.

Catalog Description:

An introduction to hardware fundamentals. Topics include constructing sample digital circuits, circuit design fundamentals, peripheral linkage design and interfaces. Also included will be the operational characteristics of and implementation factors involving different computers and peripherals (graphic adapter, multifunction cards), auxiliary storage devices and alternative I/O devices. Optimal combinations of hardware and applications software in problem solving will also be discussed.

Prerequisites:

CSC 1301--Introductory Computing: A study of the basic principles of computing, input/output media, computer software, number systems, flowcharting, and programming. The course also deals with the computer applications in business and industry.

CSC 1305--Logic and Theory: This course covers the classic, symbolic and mathematical elements of logic and their relation to computers and data processing logic and theory. Emphasis is placed on logic development through program flowcharts and structured charts.

CSC 1401--Programming in BASIC Language: An introduction to a digital computer, fundamental concepts, a study of BASIC programming language with applications and problem solving.

Text:

How to Maintain and Service Your Small Computer, by John G. Stephenson and Bob Cahill; Howard W. Sams & Co., A Division of Macmillan, Inc., 1986.

References:

Microcomputer Troubleshooting & Maintenance, by Henry F. Beechhold; Prentice Hall Press, New York, 1987.

Troubleshooting Microprocessors & Digital Logic, by Robert Goodman; Tab Books, Inc., 1986.

Computer Hardware and Organization, by M.E. Sloan; Science Research Associates, Inc., Chicago, 1973.

An Introduction to Assembly Language for The 8086 Family, by Thomas P. Skinner; John Wiley & Sons, Inc., New York, 1985.

8080A-8085 Assembly Programming, by Lance A. Leventhal; Osborne/McGraw-Hill,1978.

Programming 6502, by Rodney Zaks; Sybex Inc., 1980.

AC Circuits Reference Manual, by Control Data Educational Company, 1979.

Direct Current Reference Manual, by Control Data Educational Company, 1979.

Problem-Solving Hardware and Software, by Heathkit/Zenith, 1983.

Educational Systems, by Heathkit/Zenith, 1983.

Computer Shopper, by Computer Shopper of Titusville, Inc.,1987.

SDK-86 System Design Manual, by Intel Corporation.

Equipment and Materials Required:

Hardware:

IBM-PC, Apple, or Franklin microcomputer, scope, multimeter, ohmmeter, logic probe, meter probe, resistor, capacitors, diodes, soldering equipment, logic trainer, chips, schematic diagrams, processors, cables, disk drives, monitor, power supply, different cards, processor trainer, co-processor, and hard disk.

Software:

8086/8088 Assembler & IBM Diagnostic Disk

Video Tapes:

Video tapes on assembly of microcomputer

Instructional Process:

1. Student Lecture Guides provide outlines of lecture content, objectives, and requirements for each unit. Students should be encouraged to write definitions for vocabulary words provided in Student Lecture Guides.

2. Student Lab Guides provide outlines of laboratory assignments required and materials needed.

3. There will be several tests and laboratory assignments.

Evaluation of the Students:

Examinations: Three exams and a final will be given during the semester. The students will have an option to drop one exam out of the three. NO MAKE-UP WILL BE GIVEN WITHOUT PRIOR APPROVAL.

Laboratory Assignment: There will be fifteen lab assignments, one of which must be completed by each student after each lab section.

Final Grade Determination:

Grades for the semester will be determined based on the accumulated points earned. To determine a tentative grade, divide the total points earned by the possible points. The grading scale will be strictly: 90, 80, 70, 60 ... percent of the possible points.

Approximately 40% of the total points will be from lab assignments, 40% from the exams, and 20% from the final exam.

Competency Statement:

Microcomputer Applications Program exit competencies upon which this course is based:

Section I: Job Processing

A. Introduction/Overview

1. Demonstrate a general knowledge of computer system analysis and design.

2. Demonstrate a general knowledge of the internal operations of computers.
3. Demonstrate the ability to write a proposal for a new microcomputer system according to the specifications from the user.
4. Demonstrate the ability to install a new microcomputer system and to check acceptable performance of each component of the microcomputer.
5. Demonstrate the ability to diagnose and fix minor microcomputer problems.

B. Hardware Procedures

1. Demonstrate a knowledge of computer hardware, including input/output devices, memory, and central processing units.
2. Understand hardware capabilities and analyze hardware needs.
3. Demonstrate the ability to operate a microcomputer.
4. Utilize data backup and restore procedures.
5. Demonstrate a knowledge of routine hardware maintenance and safe storage.

Section II: Hardware Operations

A. Data Processing Equipment

1. Understand the major components of a microcomputer system.
2. Demonstrate the proper handling of microcomputer malfunctions.
3. Utilize manufacturer's reference materials.
4. Determine reason for microcomputer malfunctions.
5. Perform power-on and power-off procedures.
6. Load, start, and unload disk drives.
7. Keep logs of equipment problems.
8. Perform minor maintenance on microcomputer.
9. Initiate procedures for equipment repair.

B. Peripheral Equipment

1. Perform power-up-down procedures for peripheral equipment.
2. Perform routine maintenance on peripheral devices.
3. Operate external random disk (hard disk, video disk, etc.).
4. Operate modem.

C. Emergency Procedures

1. Perform live data protection procedures during emergency conditions (fire, flood, lightning).
2. Perform data procedures during power surge and failure.
3. Perform hardware recovery operations.
4. Perform emergency backups and power downs.

Section III: Supervisory Functions

A. Product Control

1. Review and evaluate system performance and efficiency.
2. Function as part of a team to solve user problems in information processing.
3. Prepare orientation briefings for users.

B. Equipment Operations

1. Assist with selection and purchasing of data processing equipment.
2. Define systems interface or integration requirements.
3. Estimate systems requirements and capabilities.
4. Consult with proper personnel on adequate preparation of microcomputer operating instructions.
5. Schedule and control equipment maintenance (preventive).
6. Write specifications and verifications.

Section IV: Housekeeping Function, Routine

A. Routine Maintenance of Equipment

1. Inspect diskettes and hard disk for damage.
2. Maintain and change printer ribbons.
3. Inspect and clean system hardware.
4. Perform routine maintenance on all peripheral devices or hardware.

<u>Course Outline</u>:

Contents of Unit 1: General Introduction

1. General Introduction and Computer System
2. Today's Equipment - A Service Profile
3. Servicing Your Equipment - The Options

Contents of Unit 2: Environment and Operating Procedures - Reducing Potential Problems

1. The Electronic Environment
2. The Computer Can Affect the Environment
3. Other Environmental Factors
4. Preventive Maintenance
5. Disk-Handling Procedures
6. File Management

Contents of Unit 3: Preparation, Documentation, and Tools

1. General Skills
2. Documentation and Advice
3. Test Instruments

Contents of Unit 4: Troubleshooting Striates and Skills

1. General Principles
2. Checking Discrete Components
3. Electromechanical Parts
4. Integrated Circuits (IC's)

Contents of Unit 5: Troubleshooting

1. Specific IC devices
   (a) And Gates, Or Gates, Inverter
   (b) Tristate buffers
   (c) Nand Gates, Nor gates, Flip-flops
   (d) Counters and Dividers
   (e) Comparators, Timers, Multiplexer
   (f) Shift registers
   (g) ROM & RAM
   (h) Voltage regulators

2. The System

Contents of Unit 6: Processors

1. Z80
2. 68000
3. 8086/8088
4. 80286/80386
5. Others

Contents of Unit 7: Computer Architecture & Assembly Language

1. General Architecture of a Microcomputer
2. Why Assembly Language?
   (a) Higher Level Language versus Assembly Language
3. Assemblers & Loaders
4. Debuggers
5. Number System
6. Instruction Set
7. Execution of an Assembly Language

Contents of Unit 8: Disk Drives

1. Inside a Disk Drive
2. Service Problems with Diskettes and Disk Drives
3. Maintaining Disk Drives
4. Troubleshooting Disk Drives
5. Alignment and Adjustments
6. Checking Individual Circuits and Mechanisms

Contents of Unit 9: Servicing Printers

1. Inside a Printer
2. Possible Printer Problems
3. Periodic Cleaning and Maintenance
4. Troubleshooting
5. Troubleshooting and Adjusting Specific Subsystems

Contents of Unit 10: Writing Specifications for Orders

1. Different Types of Specifications
2. Specification and Verification
3. Specification Testing
4. Manufacturers' IC Numbering System
5. Mail-order Parts Dealers
6. Pinouts and Base Diagrams

Contents of Unit 11: Troubleshooting the Main Computer and Keyboard

1. Inside a Microcomputer
2. Four Common Symptoms
3. Checking Key Signals on the CPU
4. Troubleshooting the Keyboard

Contents of Unit 12: Modems, Monitors, Cassette Recorders, and Game Controllers

1. Modems
2. Monitors
3. Cassette Recorders
4. Game Controllers

Contents of Unit 13: Troubleshooting Power Supplies

1. Power Loss in the Equipment
2. Electrical Noise in the Power Supply
3. High or Low Voltage from the Power Supply

Contents of Unit 14: Microcomputer Assembling and Upgrading

1. Assembly from Kit to System
2. System Expansion & Upgrading
3. System Performance and Evaluation
4. Networking

Contents of Unit 15: Future Prospects for Computer Hardware

1. Demand versus Price
2. A New Technology
3. A Workstation Approach
4. Communications Hardware
5. The Office of Tomorrow

INSTRUCTOR'S GUIDE

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 1

Unit Title: General Introduction

Contents of Unit:

1. General Introduction and Computer System
2. Today's Equipment - a Service Profile

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the different parts of a computer system and the function of each.
2. Describe the different types of computer system service problems.
3. Demonstrate the relationship between the age of a microcomputer and its service-related problems.
4. Describe the service equipment options.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #1

Hardware and Materials:
Tool box
Workspace
Lockers

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Tour
Demonstration
Discussion

Learning Activities:

Lecture:
Read Chapters 1, 2, & 3

Laboratory:
Complete Student's Lab Guide #1

EVALUATION:

Lecture:
None

Laboratory:
Lab #1 for grading (Performance)

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 2

Unit Title:

Environment and Operating Procedures - Reducing Potential Problems

1. The Electronic Environment
2. The Computer Can Affect the Environment
3. Other Environmental Factors
4. Preventive Maintenance
5. Disk-Handling Procedures
6. File Management

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the electronic environment.
2. Demonstrate the knowledge of preventive maintenance.
3. Demonstrate the knowledge of disk-handling and file management procedures.

Equipment and Materials Required:

Lecture:
- Text and Student's Lecture Guide #2

Hardware:
- Tool box
- Coaxial cable
- Diskettes
- Twin lead
- Varistor
- AC line & cable

Procedures:

Lecture:
- Lecture
- Demonstration

Laboratory:
- Demonstration
- Discussion

Learning Activities:

Lecture:
Read Chapter 4

Laboratory:
Complete Student's Lab Guide #2

Evaluation:

Lecture:
None

Laboratory:
Lab #2 for grading (Performance)

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 3

Unit Title: **Preparation, Documentation, and Tools**

Contents of Unit:

1. General Skills
2. Documentation and Advice
3. Test Instruments

Unit Objectives:

Upon completion of this course, the student will be able to:

1. Demonstrate good work habits.
2. Perform some safety functions.
3. Demonstrate the ability to use some test equipment.
4. Demonstrate the ability to use some electronic tools.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #3

Hardware and Materials:
Nut drivers
Screwdrivers
Scissors & pliers
Strippers
Resistor tester
Oscilloscope
Logic probe
Digital logic probe
Digital volt-ohm-milliammeter
Volt-ohm-milliammeter

Procedures:

Lecture:
- Lecture
- Demonstration

Laboratory:
- Demonstration
- Discussion

Learning Activities:

Lecture:
- Read Chapter 5

Laboratory:
- Complete Student's Lab Guide #3

Evaluation:

Lecture:
- None

Laboratory:
- Lab #3 for grading (Performance)

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 4

Unit Title: **Troubleshooting Strategies and Skills**

Contents of Unit:

1. General Principles
2. Checking Discrete Components
3. Electromechanical Parts
4. Integrated Circuits (IC's)

Unit Objectives:

1. Describe the strategic order in making repairs as quickly as possible.
2. Describe good test points.
3. Stimulate circuits for test.
4. Describe and troubleshoot discrete components of the system.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #4

Hardware and Materials:
Capacitors
Resistors
Fuses
Microcomputer
All materials from Unit #3
Diagnostic diskette

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion

Learning Activities:

Lecture:
Read Chapter 6

Laboratory:
Complete Student's Lab Guide #4

Evaluation:

Lecture:
Exam #1

Laboratory:
Lab #4 for grading (Performance)

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 5

Unit Title: **Troubleshooting**

Contents of Unit:

1. Specific IC devices:
   - And gates, Or gates and Inverter
   - Tristate Buffers
   - Nand gates, Nor gates, Flip-flops
   - Counters and Dividers
   - Comparatory, Timers and Multiplexer
   - Shift Registers
   - ROM and RAM
   - Voltage Regulators
2. The System

Unit Objectives:

1. Describe the process of troubleshooting specific IC (integrated circuit) devices.
2. Describe the pin arrangement for ROM, RAM, etc.
3. Describe and be able to identify the part of the system that is faulty.
4. Troubleshoot a system.

Equipment and Materials Required:

Lecture:
Text and Student's Guide #5

Hardware and Materials:
All materials from Units #3 and #4

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion

Learning Activities:

Lecture:
Read Chapter 7

Laboratory:
Complete Student's Lab Guide #5

Evaluation:

Lecture:
None

Laboratory:
Lab #5 for grading (Performance)

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 6

Unit Title: Processors

Contents of Unit:

1. Z80
2. 68000
3. 8086/8088
4. 80286/80386
5. Others

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Describe the different generations of processors.
2. Describe the capabilities of each of the processors.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #6

Hardware and Materials:
Different processor chips
All materials from Units #4 and #5
Tool box

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion

Learning Activities:

Lecture:
Read Heathkit/Zenith Educational System.

Laboratory:
Complete Student's Lab Guide #6

Evaluation:

Lecture:
None

Laboratory:
Lab #6 for grading (Performance)

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 7

Unit Title: Computer Architecture & Assembly Language

Contents of Unit:

1. General Architecture of a Microcomputer
2. Why Assembly Language?
3. Assemblers & Loaders
4. Number System
5. Instruction Set
6. Execution of an Assembly Language

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the knowledge of microcomputer architecture and assembly language.
2. Define different loaders and assemblers.
3. Describe the process of running an assembly language program.
4. Describe the relationship between assembly language and the architecture of a computer.
5. Define the instruction-execution cycle.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #7

Hardware and Materials:
Tool box
All materials from Units #3 and #4
ASM Assembler diskette

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion

Learning Activities:

Lecture: Read Chapters 1-3 of An Introduction to Assembly Language for the 8086 Family, by Thomas P. Skinner.

Laboratory:
Complete Student's Lab Guide #7

Evaluation:

Lecture:
None

Laboratory:
Lab #7 for grading (Performance)

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 8

Unit Title: Disk Drives

Contents of Unit:

1. Inside a Disk Drive
2. Service Problems with Diskettes and Disk Drives
3. Maintaining Disk Drives
4. Troubleshooting Disk Drives
5. Alignment and Adjustment
6. Checking Individual Circuits and Mechanisms

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate a fundamental knowledge of a disk drive.
2. Demonstrate the ability to troubleshoot a disk drive.
3. Describe diskette and disk drive management.

Equipment and Materials Required:

Lecture:
- Text and Student's Lecture Guide #8

Hardware and Materials:
- Tool box
- Diskettes
- Disk drives

Procedure:

Lecture:
- Lecture
- Demonstration

Laboratory:
- Demonstration
- Discussion

Learning Activities:

Lecture:
Read Chapter 8

Laboratory:
Complete Student's Lab Guide #8

Evaluation:

Lecture:
Exam #2 (Essay & Objective)

Laboratory:
Lab #8 for grading (Performance)

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 9

Unit Title: Servicing Printers

Contents of Unit:

1. Inside a Printer
2. Possible Printer Problems
3 Periodic Cleaning and Maintenance
4. Troubleshooting
5. Troubleshooting and Adjusting Specific Subsystems

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to troubleshoot a printer.
2. Describe different printer subsystems.
3. Demonstrate a knowledge of printer maintenance.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #9

Hardware and Materials:
Tool box
Printers

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion

Learning Activities:

Lecture:
Read Chapter 9

Laboratory:
Complete Student's Lab Guide #9

Evaluation:

Lecture:
None

Laboratory:
Lab #9 for grading (Performance)

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 10

Unit Title: Writing Specifications for Orders

Contents of Unit:

1. Different Types of Specifications
2. Specifications and Verifications
3. Specification Testing
4. Manufacturer's IC Numbering System
5. Mail-order Parts Dealers
6. Pinouts and Base Diagrams

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to write a proposal for acquiring a new system.
2. Demonstrate the ability to verify and test a system upon delivery.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #10

Hardware and Materials:
Tool box
Specification sheets

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion

Learning Activities:

Lecture:
Read Appendices A, B, C, & D

Laboratory:
Complete Student's Lab Guide #10

Evaluation:

Lecture:
None

Laboratory:
Lab #10 for grading (Performance)

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 11

Unit Title: Troubleshooting the Main Computer and Keyboard

Contents of Unit:

1. Inside a Microcomputer
2. Four Common Symptoms
3. Checking Key Signals on the CPU
4. Troubleshooting the Keyboard

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to troubleshoot the main computer and keyboard.
2. Define key signals from the CPU.
3. Define the common symptoms surrounding microcomputer problems.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #11

Hardware and Materials:
Microcomputer
Tool box
Keyboard

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion

Learning Activities:

Lecture:
Read Chapter 10

Laboratory:
Complete Student's Lab Guide #11

Evaluation:

Lecture:
None

Laboratory:
Lab #11 for grading (Performance)

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 12

Unit Title: **Modems, Monitors, Cassette Recorders and Game Controllers**

Contents of Unit:

1. Modems
2. Monitors
3. Cassette Recorders
4. Game Controllers

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate the ability to manage modems, monitors, cassette recorders, and game controllers.
2. Demonstrate the ability to troubleshoot modems, monitors, cassette recorders and game controllers.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #12

Hardware and Materials:
Modems
Monitors
Tool box
Controllers
Microcomputer

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion

Learning Activities:

Lecture:
Read Chapter 11

Laboratory:
Complete Student's Lab Guide #12

Evaluation:

Lecture:
Exam #3 (Essay & Objective)

Laboratory:
Lab #12 for grading (Performance)

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 13

Unit Title: **Troubleshooting Power Supplies**

Contents of Unit:

1. Power Loss in the Equipment
2. Electrical Noise in the Power Supply
3. High or Low Voltage from the Power Supply

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate a working knowledge of power supplies.
2. Demonstrate the ability to troubleshoot a power supply.
3. Demonstrate the ability to fine tune a power supply.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #13

Hardware and Materials:
Power supply
Tool box
Microcomputer

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion

Learning Activities:

Lecture:
Read Chapter 12

Laboratory:
Complete Student's Lab Guide #13

Evaluation:

Lecture:
None

Laboratory
Lab #13 for grading (Performance)

CST 2403: Fundamentals of Hardware

Instructor's Guide

Unit 14

Unit Title: Microcomputer Installation and Upgrading

Contents of Unit:

1. Assembly From Kit to System
2. System Expansion and Upgrading
3. System Performance and Evaluation
4. Networking

Unit Objectives:

Upon the completion of this unit, the student will be able to:

1. Demonstrate the ability to assemble a microcomputer.
2. Demonstrate a knowledge of system expansion and upgrading.
3. Demonstrate a knowledge of system performance through analysis and evaluation.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #14

Hardware and Materials:
Video on microcomputer assembly
Tool box
Microcomputer kit

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Demonstration
Discussion

Learning Activities:

Lecture:
Read Computer Shopper magazine

Laboratory:
Complete Student's Lab Guide #14

Evaluation:

Lecture:
None

Laboratory:
Lab #14 for grading (Performance)

CST 2403: Fundamentals of Hardware

INSTRUCTOR'S GUIDE

Unit 15

Unit Title: **Future Prospects for Computer Hardware**

Contents of Unit:

1. Demand versus Price
2. A New Technology
3. A Workstation Approach
4. Communications Hardware
5. The Office of Tomorrow

Unit Objectives:

Upon completion of this unit, the student will be able to:

1. Demonstrate a knowledge of the microcomputer's past and present, and understand the future prospects for computer hardware.

Equipment and Materials Required:

Lecture:
Text and Student's Lecture Guide #15

Hardware and Materials:
Tool box
Microcomputer

Procedures:

Lecture:
Lecture
Demonstration

Laboratory:
Tour
Demonstration
Discussion

Learning Activities:

Lecture:
Read Computer Shopper magazine

Laboratory:
Complete Student's Lab Guide #15

Evaluation:

Lecture:
Preparation for final exam

Laboratory:
Lab #15 for grading (Performance)